LEVIFLOW™ LFS FLOWMETERS
USER MANUAL

***LEVIFLOW™* Sensors:** *LFS-04, -08, -20, -50, -80 (LFS-Series Sensors)*
LFS-008 (Low-Flow Sensor)

***LEVIFLOW™* Converters:** *LFC-1C (single channel, LFS-Series)*
LFC-6C (6-channel, LFS-Series)
LFC-1C-F4 (single channel, LFS-008 only)

This manual contains information necessary for the safe and proper use of the *LEVIFLOW™* flowmeter series. Included are specifications for the standard configuration, components, and instructions regarding its use, installation, operation, adjustment, inspection and maintenance. For special configuration of the *LEVIFLOW™* flowmeters refer to accompanying information. If the flowmeters have to be configured for other parameter settings then the *LEVIFLOW™* configuration software (with according manual *Levitronix®* Doc.# *PL-4501-00*) is necessary. Please familiarize yourself with the contents of this manual to ensure the safe and effective use of this product. After reading, please store the manual where the personnel responsible for operating can readily refer to it at any time.

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1 Safety Precautions

CAUTION
Do not under any circumstances open the converter or sensor housing. Levitronix does not assume responsibility for any damage, which occurs under such circumstances.

	⚠ WARNING
	***Hazardous voltage may be present.*** *In case of the usage of an inadequate AC/DC power supply, mains voltages may be present (even if the system is designed for 24VDC).* *The converter must be placed in a spill protected environment. Do not under any circumstances open the powered converter.* *The usage of galvanic separated AC/DC supply is highly recommended* (preferable with *UL 1950*, *UL 508C* and/or *IEC/EN60950*).

	⚠ WARNING	
	***TOXIC CHEMICALS may be present.*** *When using the flowmeter to measure chemicals skin contact and toxic gases may be hazardous to your health. Wear safety gloves and other appropriate safety equipment.*	

2 Specifications

2.1 Component Overview

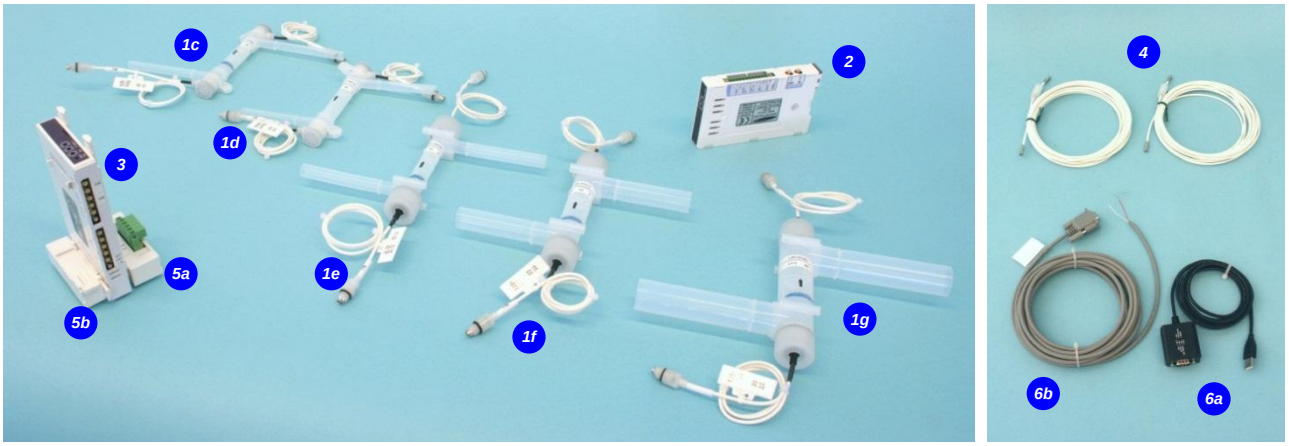


Figure 1: LEVIFLOW™ flowmeter components

Pos.	Part Name	Part #	Shape	Flow	Fitting	Cable Jacket	Cable Length	Special Feature	Note
1a	LFS-008-Z LFS-008-U	100-30323 100-30324	Z U	0 – 0.8 lpm	1/4"	FEP	0.5 m	PVDF male connector cover	Sensor specific parameter for converter calibration are delivered on a tag attached to the flowsensor.
1b	LFS-04-Z-T025 LFS-04-U-T025	100-30321 100-30322	Z U	0 – 4 lpm	1/4"				
1c	LFS-04-Z LFS-04-U	100-30304 100-30305	Z U	0 – 4 lpm	3/8"				
1d	LFS-08-Z LFS-08-U	100-30306 100-30307	Z U	0 – 8 lpm	3/8"				
1e	LFS-20-Z LFS-20-U	100-30308 100-30309	Z U	0 – 20 lpm	1/2"				
1f	LFS-50-Z LFS-50-U	100-30310 100-30311	Z U	0 – 50 lpm	3/4"				
1g	LFS-80-Z LFS-80-U	100-30312 100-30313	Z U	0 – 80 lpm	1"				

Table 1: Standard flow sensor models

Pos.	Article Name	Part #	Description	Interfaces
2a	LFC-1C	100-30314	Single Channel Converter	Analog Output (4 – 20 mA), 2x Digital Output, 1x Digital Input, RS485 (MODBUS) protocol
2b	LFC-1C-F4	100-30325		
3	LFC-6C	100-30315	6-Channel Converter	- RS485 (MODBUS) protocol - Note: Connector and Termination Box to be ordered as separate article (see Table 3)

Table 2: Standard converters

Pos.	Article Name	Part #	Features	Special Feature
4a	LFE-A.1-10 LFE-A.1-30 LFE-A.1-60	190-10162 190-10163 190-10164	Cable length: 1 m, PVC Cable length: 3 m, PVC Cable length: 6 m, PVC	- PVDF female connector cover for IP-65 chemical protection - Flame retardant PVC white (UL VW-1 corresponds to EN-60332-1-2)
4b	LFE-A.2-10 LFE-A.2-30 LFE-A.2-60	190-10165 190-10166 190-10167	Cable length 1 m, FEP Cable length 3 m, FEP Cable length 6 m, FEP	- PVDF female connector cover for IP-65 chemical protection
5a	Connector Box for LFC-6C	100-30316	COMBICON connector	Is needed for wiring stacks of LFC-6C converters
5b	Termination Box for LFC-6C	100-30317	--	Is needed for termination of RS485 bus
6a	EX-1303	100-30318	USB-RS485/RS422 Adaptor	For PC communication with converters over RS485 bus
6b	RS485 Cable	100-30319	D-SUB Connector with Open-End Cable	For wiring, when used with EX-1303

Table 3: Accessories

Pos.	Part Name	Part #	Flow Range	Fitting	Cable Jacket	Sensor Cable Length	Note
6a	LFS-008-Z + LFC-1C-F4 LFS-008-U + LFC-1C-F4	100-90625 100-90626	0 – 0.8 lpm	1/4"	FEP	0.5 m	Converter is delivered with sensor specific parameters already stored. Extension cables to be ordered as separate article with specified length (see Table 2)
6b	LFS-04-Z-T025+LFC-1C LFS-04-U-T025+LFC-1C	100-90627 100-90628	0 – 4 lpm	1/4"			
6c	LFS-04-Z+LFC-1C LFS-04-U+LFC-1C	100-90604 100-90605	0 – 4 lpm	3/8"			
6d	LFS-08-Z+LFC-1C LFS-08-U+LFC-1C	100-90606 100-90607	0 – 8 lpm	3/8"			
6e	LFS-20-Z+LFC-1C LFS-20-U+LFC-1C	100-90608 100-90609	0 – 20 lpm	1/2"			
6f	LFS-50-Z+LFC-1C LFS-50-U+LFC-1C	100-90621 100-90622	0 – 50 lpm	3/4"			
6g	LFS-80-Z+LFC-1C LFS-80-U+LFC-1C	100-90623 100-90624	0 – 80 lpm	1"			

Table 4: Flowmeter sets – flowsensor with single channel converter LFC-1C/LFC-1C-F4

2.2 Standard System Configurations

2.2.1 Single Channel Configuration – LFS-Series

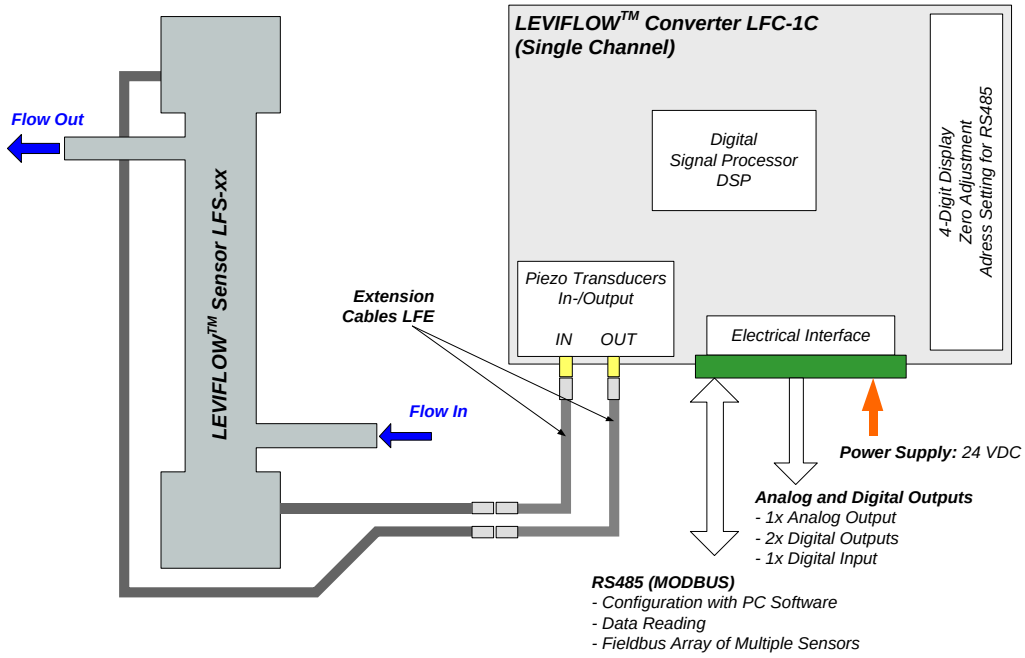


Figure 2: Flowmeter configuration with LFC-1C single channel converter
(for LFS-008 flow sensor special LFC-1C-F4 converter is necessary)

2.2.2 Multi-Channel Configuration – LFS-Series

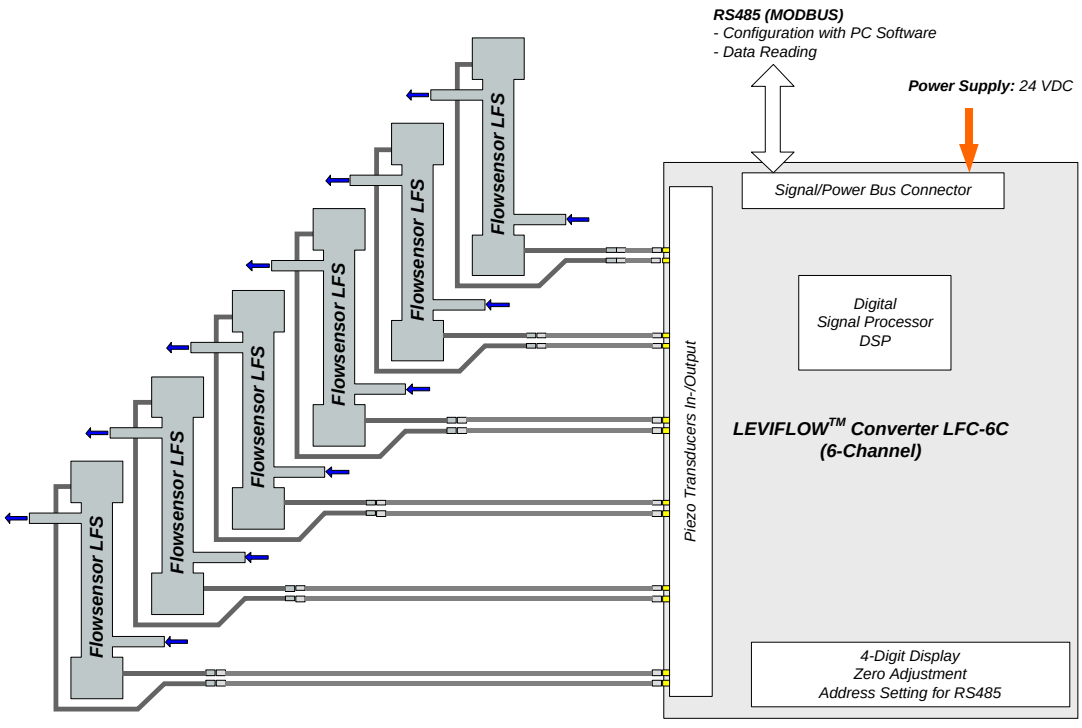


Figure 3: Flowmeter configuration with LFC-6C converter *(6 channel)*
(Does not work with LFS-008 flow sensor)

2.3 Specifications of Sensors

Characteristics \ Sensor Type		LFS-008	LFS-04	LFS-08	LFS-20	LFS-50	LFS-80
Flow Range [lpm]		0 – 0.8	0 – 4	0 – 8	0 – 20	0 – 50	0 – 80
Fitting Tube Size (OD)		1/4"	1/4" or 3/8"	3/8"	1/2"	3/4"	1"
Measurement Path ID in [mm]		2.5	4	6	10	15	20
Accuracy Flow Velocity < 1 m/s	Flow Range [lpm]	0.29 – 0.8	0 – 0.8	0 – 1.7	0 – 4.7	0 – 10.6	0 – 18.8
	Accuracy [lpm]	see Figure 4	± 0.008	± 0 – 0.017	± 0.047	± 0.106	± 0.188
	Repeatability [lpm]	see Figure 4	< 0.004	< 0.009	< 0.024	< 0.053	< 0.94
Accuracy Flow Velocity > 1 m/s	Flow Range [lpm]	0.29 – 0.8	0.8 – 4	1.7 – 8	4.7 – 20	10.6 – 50	18.8 – 80
	Accuracy of Reading	± 1%	± 1%	± 1%	± 1%	± 1%	± 1%
	Repeatability of Read.	< 0.5%	< 0.5%	< 0.5%	± 0.5%	± 0.5%	± 0.5%
Weight [g]		97	97	95	115	150	180
Pressure Drop Coefficient C $\Delta P = C \times Q^2$, Q = Flow [lpm], ΔP = Press. Drop [kPa]		16.8	1.80 (3/8" fitting)	0.88	0.06	0.01	0.003
Fluid Temperature		Normal range: 10 – 90 °C (50 – 194 °F) Max. temperature: 160 °C (320 °F) [1] (not for LFS-008)					
Ambient Temperature		0 – 60 °C (32 - 140 °F)					
Maximum Fluid Pressure		0 – 0.5 MPa (0 – 5 bar, 0 – 72.5 psi)					
Kinematic Viscosity		0.8 – 40 mm^2/s (0.8 – 40 cSt)					
Sound Speed		1000 – 2200 m/s					
Wet Materials		PFA					
Sensor Enclosure Classification		IP-65					
Cable Jacket Material		FEP (PVC on request and at minimum order quantities)					
Standard Cable Length		0.5m with extension cables for length variation (other length on request and at minimum order quantities)					
Electrical Connectors		SMB with protective PVDF cover (male with O-Ring, IP-65 protection)					

Table 5: Specifications of sensors (All data based on water at 20 °C)

[1]: The flow sensors LFS-04/08/20/50/80 are functionally tested up to 160°C liquid temperature. However, no lifetime and MTBF data can be given for the high temperature range. Levitronix® reject warranty for Leviflow products used at liquid temperatures > 90°C. For further specific information please contact Levitronix.

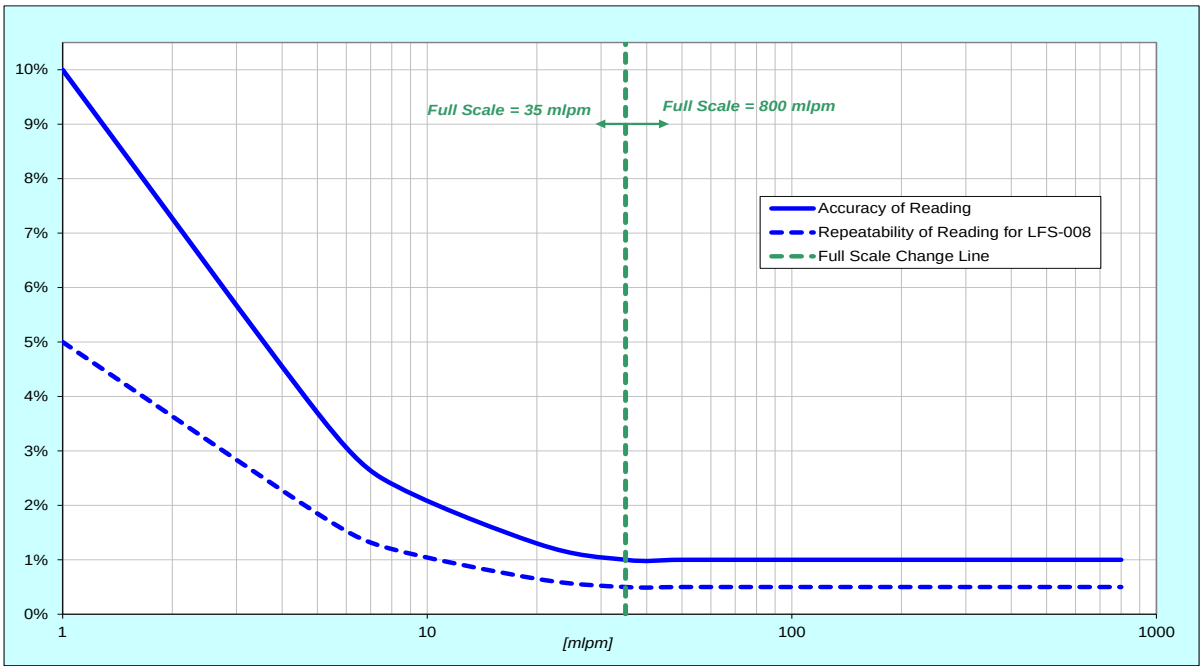


Figure 4: Repeatability and accuracy specification for LFS-008 sensor

2.4 Specifications of Converters

2.4.1 General Specifications

Characteristics	Single Channel Converter Types LFC-1C/LFC-1C-F4	6-Channel Converter Type LFC-6C
Power Supply Current / Start Current	24 VDC ± 10% 150 mA / 4.4 A, 2 ms max.	24 VDC ± 10% 150 mA / 4.4 A, 2 ms max.
Ambient Temp Humidity Range	0 – 50 °C (32 – 122 °F) 30 - 85% R.H. (no condensation)	0 – 50 °C (32 – 122 °F) 30 - 85% R.H. (no condensation)
Enclosure Classification and Material	IP-20 (indoor use), ABS	IP-20 (indoor use), ABS
Interfaces (see Figure 7 and Figure 9 for detailed PIN designation and electrical specification)	- RS485 -> MODBUS protocol -> max. array of 99 channels - 1x Analog Output: 4 – 20mA (0 – 20mA configurable) - 2x Digital Outputs: Flow Alarm, Measurement Error, Volume Counter Pulse, Volume Counter Alarm, Flow as Frequency or Bubble Detection (default: normally open) - 1x Digital Input: Volume Counter Reset or Zero Adjust - 4 Digit display (flow rate, error codes), re-zero button - Address potentiometers for RS485 address setting	- RS485 -> MODBUS protocol -> max. array of 99 ch. - stacking of max. 16 converters -> 5 ms DSP process/time per channel - 4 Digit display (flow rate, error codes), re-zero button - Address potentiometers for RS485 address setting
Configuration Parameters (Available and configurable with RS485/USB converter and configuration software)	- Viscosity - Low Cutoff, - Dampening time (filter) - Full scale setting, - Linearization (15 points) - Alarm Outputs (High and Low Alarm) - Volume Counter and Volume Counter Alarm Settings	- Viscosity - Low Cutoff - Dampening constant (filter) - Full scale setting - Linearization (15 points) - Alarm Outputs (High and Low Alarm) - Volume Counter and Volume Counter Alarm Settings
Weight	130 g	170 g
Mounting	DIN rail	DIN rail
Dimensions	123 x 75 x 17.5 mm	139 x 75 x 17.5
Duration for Activation of Manual and Digital Zeroing	3 sec	3 sec
Duration of Zeroing Procedure	LFC-1C -> normal 6 sec maximum 15 sec LFC-1C-F4 -> normal 26 sec maximum 60 sec.	normal 15 sec maximum 30 sec.
Duration of Measurement Ready after Power-On	10 sec.	10 sec.
Warm-Up Time for Full Performance Measurements	30 min.	30 min.

Table 6: Specifications of converters

2.4.2 Overview of Parameter Configuration

Table 7 shows the standard ("Default") and possible parameter configurations of the flowmeters. This user manual is dealing with the standard configuration. For setting up other configurations the *LEVIFLOW™ Configuration Software* is needed. Consult the "*Configuration-SW User Manual*" (*Levitronix® Doc.# PL-4501-00*) for more detailed description.

Block	Parameter	Option/Range	Default	Note
Basic	Sensor size	LFS-xx xx = 04, 08, 20, 50, 80, 008	xx = 008,4,8,20,50,80 (accord. Sensor size)	--
	Full scale	0.01 – 100 L/min	(accord. Sensor size)	Default Values: LFS-008 = 0.8 L/min, LFS-04 = 4 L/min, LFS-08 = 8 L/min LFS-20 = 20 L/min, LFS-50 = 50 L/min, LFS-80 = 80 L/min
	Unit of flow in display	L/min or mL/min	L/min	Unit of flow rate on the converter display
	Damping time	0 – 25 s	0.2 s	Low-pass filter with $f_{3dB} = \frac{1}{2\pi \cdot T}$
	Low cutoff	0.0 – 25.0 %	2 %	Flow cut to 0 below this percentage of full-scale If cutoff 0% is chosen, negative flow becomes visible
	Kinematic Viscosity	0.00 – 99.99 cSt	1 cSt	Kinematic Visc. = Dynamic Visc. / Density
Analog output settings (For LFC-1C / LFC-1C-F4 only)	Analog output setting	4 – 20 mA or 0 – 20 mA	4 – 20 mA	--
Digital input settings (For LFC-1C / LFC-1C-F4 only)	Digital input	Volume counter reset	Zero adjust	Set Volume Counter to zero
		Zero adjust		Automates zeroing, when liquid type changes
Digital output settings (For LFC-1C / LFC-1C-F4 only)	Digital output 1	Flow alarm High Flow alarm Low Vol. counter alarm H Vol. counter alarm HH Vol. counter Pulse Measurement Error Flow as Frequency Bubble detect Custom Output	Flow alarm High	- Upper flow limit detection - Lower flow limit detection - Flow volume detection first value (one-time) - Flow volume detection second value - Pulse per volume - Error signal (empty sensor etc.) - Flow as Frequency output (100% of full-scale = 1 kHz) - Bubble detected signal - Bits of equipment status can be OR-ed on the output
	Digital output 2		Flow alarm Low	
Flow alarm	Hysteresis (Flow alarm)	0 – 20 %	0 %	Can be used to get tolerance to noise.
	Alarm high	0 – 125 %	105 %	Alarm setting In percentage of full-scale.
	Contact type	N.O. = normally open N.C. = normally closed	N.O. = norm. open	For digital outputs of LFC-1C / LFC-1C-F4 / LFC-1C-CS only.
	Alarm low	-10 – 125 %	-5 %	Alarm setting In percentage of full-scale.
	Contact type	N.O. = normally open N.C. = normally closed	N.O. = norm. open	For digital outputs of LFC-1C / LFC-1C-F4 / LFC-1C-CS only.
Volume counter settings	Volume counter enable (activation box)	activated, not activated	not activated	These are settings for volume detection (integration of flow). Has to be active for the options " Vol. Counter Alarm H", "Vol. Counter Alarm HH" and "Vol. Counter Pulse".
	Volume counter base unit	1 mL, 1 L, 1 m3	1 mL	
	Multiplier factor	0.01, 0.1, 10, 100, 1000	0.1	
	Volume counter pulse length	0.5, 50, 100ms	0.5 ms	
	Volume counter alarm enable (activation box)	activated, not activated	not active	-> Settings for one-time volume detection. -> Volume = "Volume unit" x "Multiplier factor" x "Vol. Counter Alarm H" value" -> Has to be active for the options "Vol. Counter Alarm H", "Vol. Counter Alarm HH".
	Value (Volume counter alarm H)	0 – 999999	--	
	Contact type (H)	N.O. = normally open N.C. = normally closed	N.O. = norm. open	
	Value (Volume counter alarm HH)	0 – 999999	--	
	Contact type (HH)	N.O. = normally open N.C. = normally closed	N.O. = norm. open	
Measurement Error Settings	Instant Measurement Error Ignore Time	0-99 s	10s	During this time instant measurement errors are ignored. If an instant measurement error stays active for longer time than this time, measurement error arises.
	Flow Level on Measurement Error	0%, -25, 125% Hold	0 %	Signal level of analog output and flow, when measurement error arises
Bubble Detection Settings	Bubble Detect Hold Time	0 – 99 s	0 s	For bubble or particle detection in the process

Table 7: Overview of parameters

2.5 Basic Dimensions of Main Components

2.5.1 Dimensions of Sensors

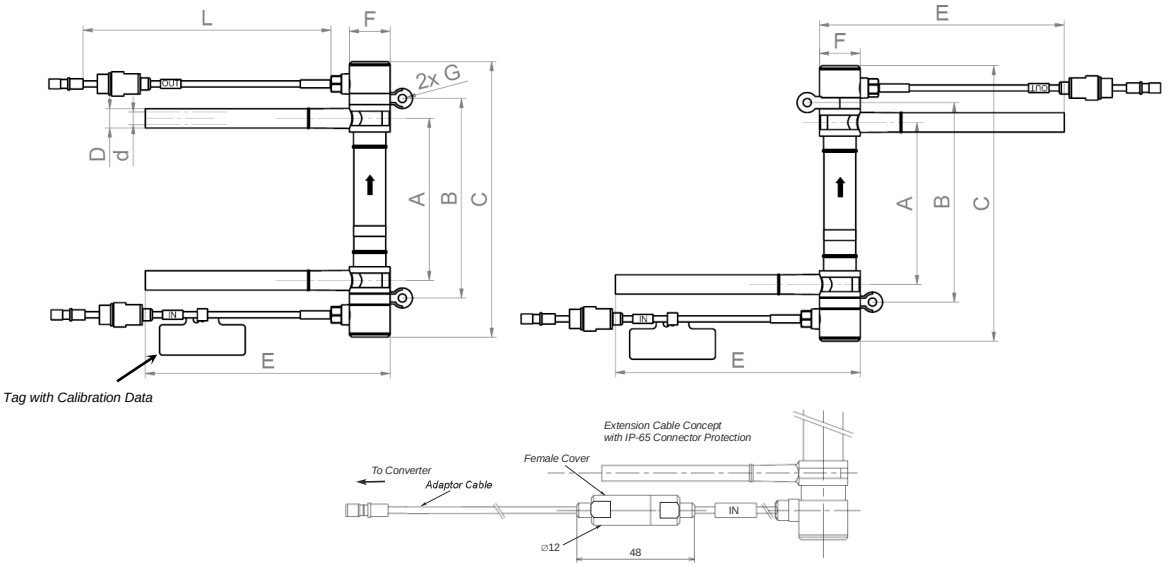


Figure 5: Dimension legend for LFS-04 and LFS-08 sensors
(left: U-shape, right: Z-shape)

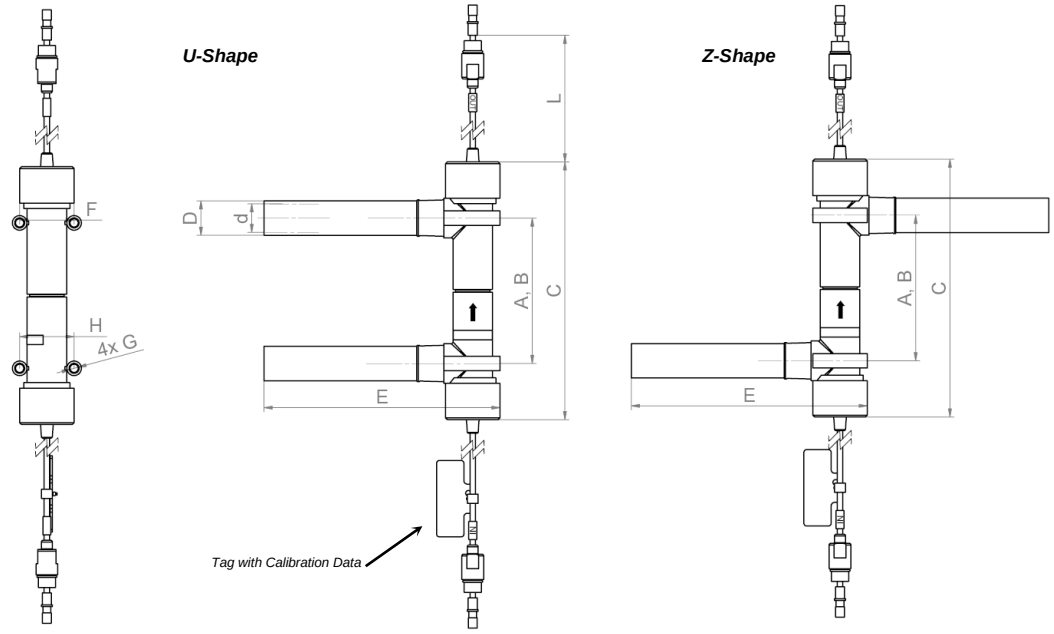
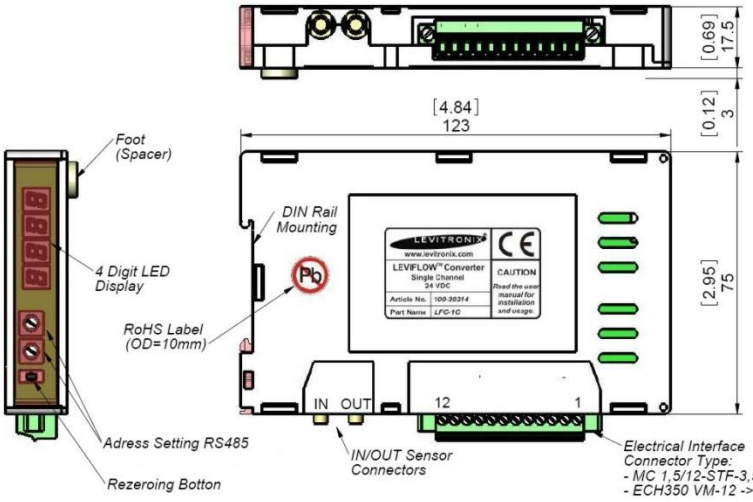


Figure 6: Dimension legend for flowsensors LFS-20, LFS-50 and LFS-80
(left: U-shape, right: Z-shape)

Sensor Type	Tube Size	Dimensions in [mm]									
		A	B	C	D	d	E	F	G	H	L
LFS-008	1/4"	80 ±1	96 ±1	134 ±1	6.35	4.35	120	ϕ20	ϕ4	--	500
LFS-04	3/8" 1/4"	80 ±1	98.5 ±1 96 ±1	136 ±1 134 ±1	9.53 6.35	6.33 4.35	120	ϕ20	ϕ4	--	500
LFS-08	3/8"	80 ±1	98.5 ±1	136 ±1	9.53	6.33	120	ϕ20	ϕ4	--	500
LFS-20	1/2"	80 ±1	80 ±1	136 ±1	12.7	9.5	120	ϕ30	M4 x 31 -> U-shape M4 x 30 -> Z-shape	25	500
LFS-50	3/4"	80 ±1	80 ±1	141.8 ±1	19	15.8	130	ϕ30	M5 x 31 -> U-shape M5 x 30 -> Z-shape	30	500
LFS-80	1"	80 ±1	80 ±1	148 ±1	25.4	22.2	140	ϕ30	M4 x 34 -> U-shape M4 x 30 -> Z-shape	35	500

Table 8: Sensor dimensions

2.5.2 Dimensions of Converters



PIN	Designation	Specification
1	DC24V+	24 VDC ± 10% Current: 150 mA Starting: 4.4 A, 2ms
2	DC24V-	
3	FG	Field Ground
4	Analog Out +	4 - 20 mA (0 - 20 mA configurable) Load Resistance < 600 Ohm
5	Analog Out -	
6	Digital Out1 +	Max. rating: DC30V, 20mA (open collector) Various configurable options available depending on firmware
7	Digital Out2 +	
8	COM	
9	Digital In+	Various configurable options available depending on firmware No-voltage contact or transistor open collector
10	Digital In-	
11	RS485 +	RS485 with MODBUS Protocol
12	RS485 -	

Figure 7: Dimensions and layout of interfaces of single channel converter LFC-1C / LFC-1C-F4

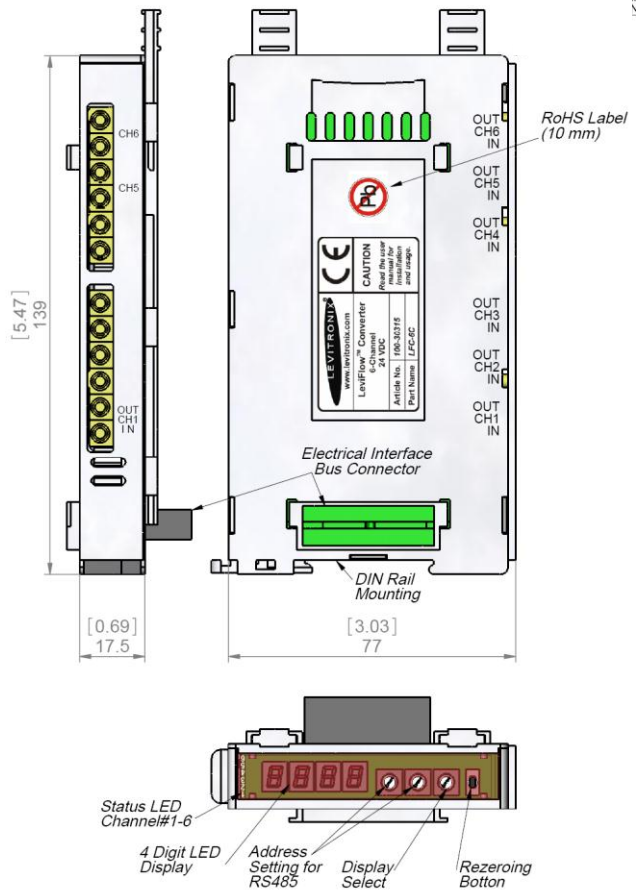
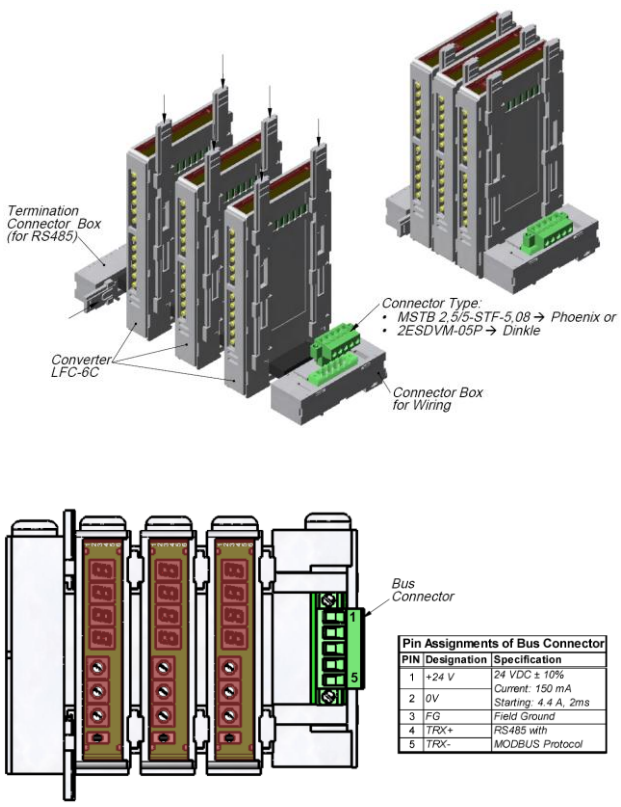


Figure 8: Dimensions 6-channel converter LFC-6C



Pin Assignments of Bus Connector		
PIN	Designation	Specification
1	+24 V	24 VDC ± 10% Current: 150 mA Starting: 4.4 A, 2ms
2	0V	
3	FG	Field Ground
4	TRX+	RS485 with
5	TRX-	MODBUS Protocol

Figure 9: Mounting and stacking concept for converter LFC-6C

3 Installation

3.1 Installation of Converter *LFC-1C / LFC-1C-F4*

3.1.1 Overview and Preparation

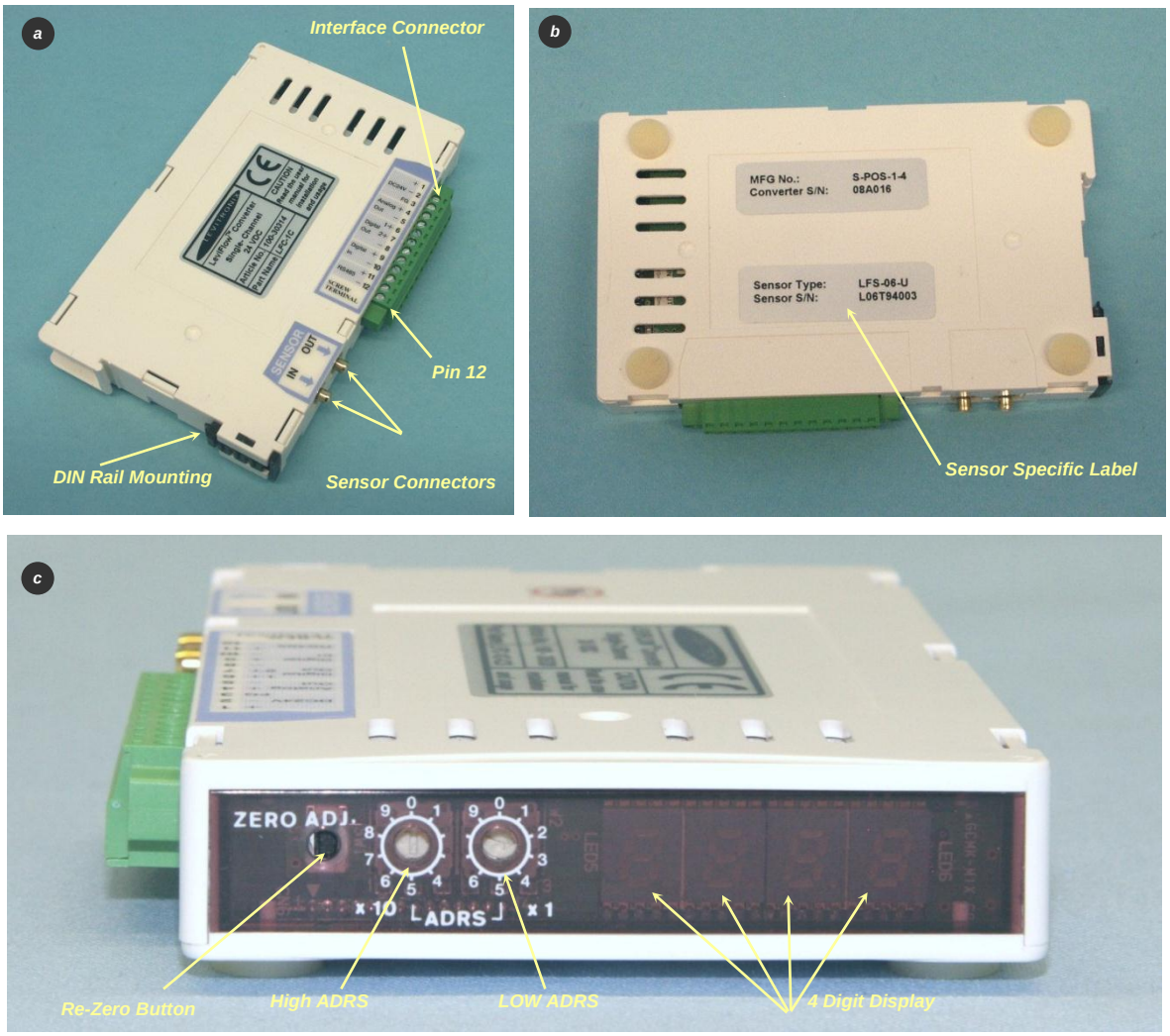


Figure 10: Single channel converter LFC-1C / LFC-1C-F4

1. Check if the *Sensor S/N* (serial number) and the *Sensor Type* on the sensor specific label on the converter back side (see *Figure 10b*) corresponds to the data of the used sensor. If no sensor specific label is applied on the converter the *LEVIFLOW™ Configuration Software* (see *Section 4.4*) has to be used to load the sensor specific calibration data (available on the sensor tag, see *Figure 6*) to the converter. Consult the configuration "*Configuration-SW User Manual*" (*Levitronix®* Doc.# *PL-4501-00*) for handling with the *LEVIFLOW™* configuration software

   Note: If the converter and the flow sensor are ordered and delivered as a set (see Table 4), the sensor specific data is already stored in the converter and the according label is applied on the converter back side.
2. If communication over the RS485 bus is used, check the address settings of the potentiometers on the front panel of the converter (see *Figure 10c*). The total address is: "High ADRS" x 10 + "Low ADRS" x 1
3. The *LEVIFLOW™ Configuration Software* can be used to debug and configure the flowmeter over the RS485. For communication with RS485 the MODBUS protocol can be requested at *Levitronix®*.

3.1.2 Instructions for Electrical Installation

1. Remove the DC power from the converter.
2. Remove the interface connector (see *Figure 10a*) from the converter
3. Attach the necessary wires (AWG 14-26) according to the pin specifications in *Figure 7*.
4. Strip the sheath approximately 3mm from the wires end. Insert core into terminal to the end and tighten the screw. Confirm that the wires are securely fixed by pulling it gently by hand.
5. For usage of a fuse at the power input (24 VDC) a 200 mA slow-blow type is recommended. The peak current after power on of the converter is 4.4 A during 2 ms, which has to be considered, when choosing the fuse type and the AC/DC power supply.
6. Mount the interface connector to the converter and tighten the 2 connector screws.
7. Attach the SMB connectors of the sensor extension cable and assure the “IN” and “OUT” labels of the converter fit with the labels of the extension cable.
8. Do not pull directly on the cable when disconnecting it from the converter. Use the end of the SMB connector to pull it.
9. Before powering on check again all wiring connections. Confirm that the terminals are securely fastened and that there is no possibility of short circuit.

3.1.3 Instructions for Mechanical Installation

⚠ WARNING

Hazardous voltage may be present.

In order to avoiding fluid spills shorting voltages within the converter, place the controller in a spill protected environment (for example protected electronic cabinets).

If explosive flammable gases are present, place the converter in an explosion-proof cabinet.

1. The converter shall be installed in a spill protected cabinet.
2. Assure that sufficient ventilation is provided in order to avoid exceeding the allowed ambient temperature and humidity range:
   - ➔ *Temperature range:* *0 – 50 °C (32 – 122 °F)*
   - ➔ *Humidity range:* *30 - 85% R.H. (no condensation)*
3. Mount the converter on a DIN rail (see *Figure 10a*).

3.2 Installation of Converter *LFC-6C*

3.2.1 Overview and Preparation

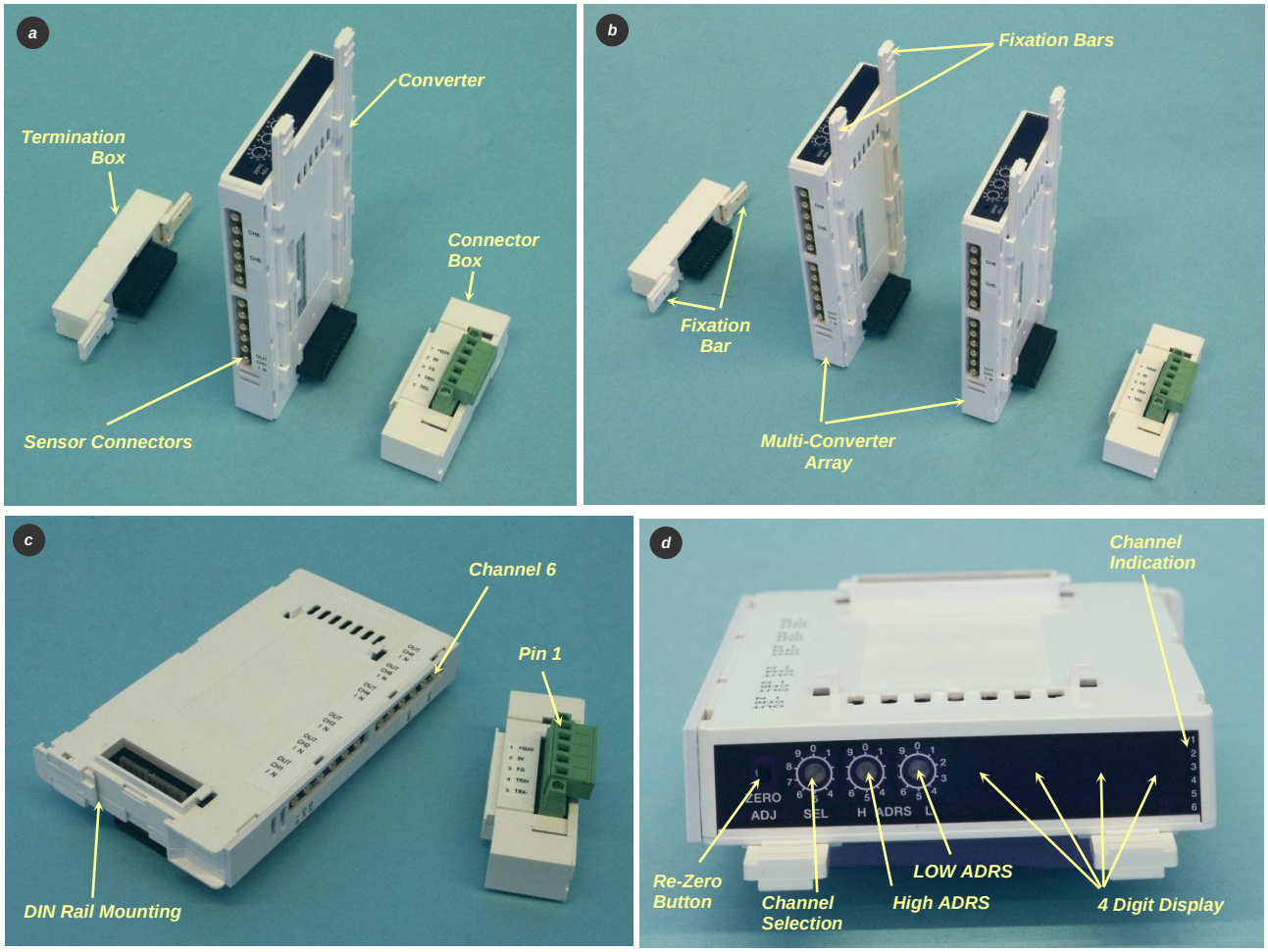


Figure 11: 6-channel controller LFC-6C

1. Check if all parts are delivered as shown in *Figure 11*. For every configuration (single converter as shown in *Figure 11a* and multi converter array as in *Figure 11b*) a termination box (resistance to terminate the RS485) and a connector box (wiring) is needed.
2. For communication with RS485 check the address settings of the potentiometers on the front panel of the converter (see Figure 11*d*). The total address of the first channel is:
   "High ADRS" x 10 + "Low ADRS" x 1
3. The *LEVIFLOW™ Configuration Software* can be used to debug and configure the flowmeter over the RS485. For communication with RS485 the MODBUS protocol can be requested at *Levitronix®*.

3.2.2 Instructions for Electrical Installation

1. Remove the DC power from the converter.
2. Remove the interface connector on the connector box (see *Figure 11b*)
3. Attach the necessary wires (AWG 14-26) according to the pin specifications in *Figure 9*. Strip the sheath approximately 3mm from the wires end. Insert the core into the connector up to the end and tighten the screw. Confirm that the wires are securely fixed by pulling it by hand.
4. For usage of a fuse at the power input (24 VDC) a 200 mA slow-blow type is recommended. The peak current after power on of the converter is 4.4 A during 2 ms, which has to be considered, when choosing the fuse type and the AC/DC power supply.
5. Mount the interface connector to the converter and tighten the 2 connector screws.
6. Before powering on, check again all wiring connections. Confirm that the terminals are securely fastened and that there is no possibility of short circuit.

3.2.3 Instructions for Mechanical Installation

⚠ WARNING

Hazardous voltage may be present.

In order to avoiding fluid spills shorting mains or other voltages within the controller, place the converter in a spill protected environment (for example protected electronic cabinets).

If explosive flammable gases are present, place the converter in an explosion-proof cabinet.

1. The converter shall be installed in a spill protected cabinet.
2. Assure that sufficient ventilation is provided in order to avoid exceeding the allowed ambient temperature and humidity range:
   - ➔ *Temperature range:* *0 – 50 °C (32 – 122 °F)*
   - ➔ *Humidity range:* *30 - 85% R.H. (no condensation)*
3. Bring the fixation bars in to un-lock position (see *Figure 9*).
4. If multiple converters are used (see *Figure 11b*) stack them together.
5. Attach the connector box (see *Figure 11a*)
6. Attach the termination box (*Figure 11a*) and fix it by pushing the fixation bars of the termination box (see *Figure 11b and Figure 9*) to the inside.
7. Bring the fixation bars into the locked position (see *Figure 9* and *Figure 11b*)
8. Mount the whole stack on a DIN rail.

3.2.4 Configuration of Sensor Specific Data

In his standard configuration the converter comes shipped without sensor specific data stored. The *K-Factor* and the *5 Calibration Values* of each sensor have to be stored to the converter with the *LEVIFLOW™* configuration software. The *K-Factor* and the *5 Calibration Values* (*11* for LFS-008) are available on the sensor tag and on a calibration sheet delivered with each sensor.

Consult the configuration "*Configuration-SW User Manual*" (*Levitronix®* Doc.# *PL-4501-00*) for handling with the *LEVIFLOW™* configuration software.

3.3 Installation of Sensors

3.3.1 Overview and Preparation

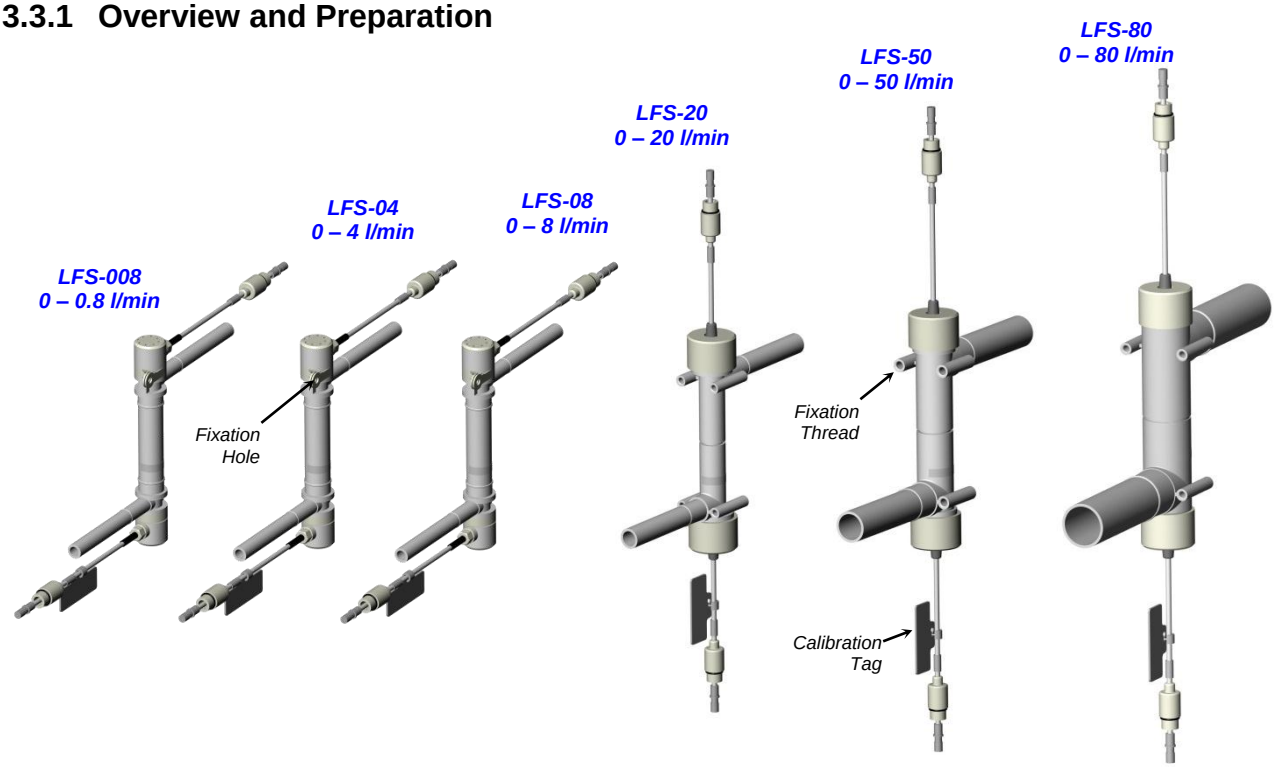


Figure 12: Flowsensor models

1. Check if the sensor contains the calibration tag (with *K-Factor* and *5 Calibration Values*) and if the data corresponds to the values on the calibration sheet delivered with each sensor.
2. Please store the delivered calibration sheet or its data on a defined storage place in order to be able to refer to it in case that the converter is exchanged and that the tag was removed.

3.3.2 Instructions for Electrical Installation

1. Attach the SMB connectors from the sensors to the converter and verify that “IN”/“OUT” labeling on the converter corresponds to the labeling on the sensor cables.
2. For sensor cable length variations the extension cables can be used (described in *Table 3*). Similar to the sensor cables, the pair of extension cables is labeled accordingly with “IN” and “OUT”. Screw together the two connector protection covers of the sensor (male) and the extension cables (female) (see *Figure 5*) in order to achieve an IP-65 protection of the connectors. Do not shorten the cables on-site as a special tool is needed to assemble the SMB connectors.
3. Do not pull directly on the cable when disconnecting it from the converter. Use the end of the SMB connector to pull it.
4. After start-up a Zeroing is recommended. Assure that the sensor is completely filled with the according fluid, is free of bubbles and that zero flow is realized. Then push the “ZERO ADJ” button on the converters for about three seconds. During adjustment “0ADJ” appears on the converter display.

3.3.3 Instructions for Mechanical and Hydraulic Installation

1. In order to mechanically fix the sensor body 2 fixation holes can be used for the *LFS-008* and *LFS-04/08* models (see *Figure 5* and *Figure 12*) and 4 threads for the *LFS-20/50/80* models (see *Figure 6* and *Figure 12*).
2. Assure that at the mounting location the allowed ambient temperature and humidity ranges are not exceeded:
   - ➔ *Temperature range:* *0 – 60 °C (32 – 140 °F)*
   - ➔ *Humidity range:* *30 - 85% R.H. (no condensation)*
3. The flow circuit should be completely filled with fluid. The converter DSP (Digital Signal Processor) contains special algorithms, which increase the robustness of the measurement against bubbles. However, assure that excessive bubbles are avoided in the circuit.
4. Ideal mounting position for the flow sensor is 45^0 (see *Figure 13*) with upward flow direction to avoid the stagnation of bubbles and particles in the measuring tube.

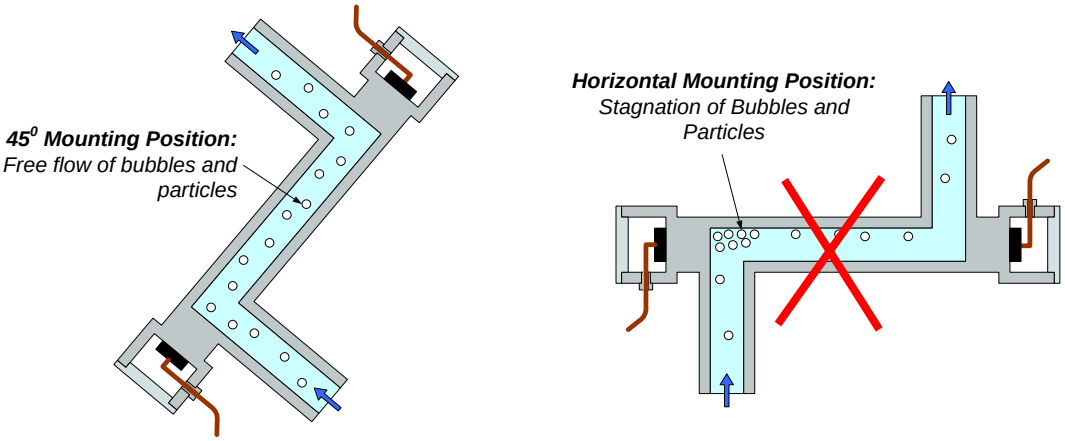


Figure 13: Mounting position of flowsensor

5. An arrow mark on the flow sensor (see *Figure 5* and *Figure 6*) indicates the flow direction. Make sure that the arrow corresponds to the direction of the flow in the hydraulic circuit.
6. Avoid excessive vibrations such as in the neighborhood of displacement pumps. Insufficient contact of the transducer (within the sensor) onto the pipe wall caused by vibration may result in inaccurate measurement.
7. The flowmeter measures flow velocity. In order to obtain fully developed flow pattern for accurate velocity measurement, straight run of 10x sensor ID upstream and of 5x ID downstream is recommended (see *Table 5* for ID specifications of the sensor models). If non-uniform turbulent flow or swirl flow is expected, install longer upstream straight run and/or a flow-rectifier.
8. To install on pipe that has open end, the sensor should be mounted in lower position of the pipe line.
9. The sensor should be mounted where pressure in the pipe is above the atmospheric pressure.
10. Devices like valves are recommended to be installed downstream of the sensor in order to prevent formation of bubbles in the liquid. An upstream valve may form bubbles reducing the intensity of the ultrasound signal and interfering with measurement.
11. A bypass pipe run (including bypass valve and shutoff valve) is recommended for easy zero adjustment and maintenance.
12. Please confirm that the maximum pressure is below the in *Table 5* specified pressure of the sensor.
13. After setup a “Zeroing” is recommended. Assure that the sensor is completely filled with the according fluid and is free of bubbles. Stable liquid properties should be assured by flushing the circuit with the final liquid until temperature and viscosity becomes stable. After this zero flow shall be realized. Then push the “ZERO ADJ” button on the converters for about 3 seconds. During adjustment “0ADJ” appears on the converter display.
14. If Re-Zeroing is regularly necessary, automation is possible over the digital input of the converter.
15. In the following cases a re-zero is recommended:
    a. 30 minutes after power-on of a cool converter and sensor
    b. Change of fluid properties (temperature, viscosity, density)
    c. Change of chemistry
    d. Change of the hydraulic circuit

4 Operation

4.1 General Timing Specifications

4.1.1 Startup Time

After power-on *a LEVIFLOW™* converter startup sequence with information about converter type, firmware version and baud rate is proceeded. During this sequence flow measurement is not performed. Start-up time is about 8 seconds for every converter type.

4.1.2 Thermal Stability Time

To guarantee specified accuracy thermal stability of sensor has to be reached. Therefore it is recommended to wait 30 minutes after power-on of converter or after connecting a new sensor to the converter.

4.1.3 Zero Adjustment Activation Time

There are three possibilities to activate zero adjustment:

1. Activating by *LEVIFLOW™* configuration software: Zero adjustment starts immediately after pressing corresponding button
2. Activating by re-zero button on converter front (see *Figure 10c* resp. *Figure 11d*): button has to be pressed during 3 seconds to initiate zero adjustment.
3. Activation by digital input (default configuration): digital input has to be active during 3 seconds to initiate zero adjustment.

4.1.4 Automatic Zero Adjustment duration

The duration to perform an automatic zero adjustment is converter-type specific:

Converter type	Typical duration	Maximum duration
LFC-1C	6 sec	15 sec
LFC-6C	15 sec	30 sec
LFC-1C-F4	26 sec	60 sec

Figure 14: Zeroing duration for converters

4.2 System Operation with *LFC-1C / LFC-1C-F4*

4.2.1 Standard Operation with PLC Interface

Table 9 shows the standard configuration of the electrical interface (PLC). For other configurations the *LEVIFLOW™* configuration software has to be used (according manual is *Levitronix®* Doc.# *PL-4501-00*).

PIN	Designation	Specification	Standard Configuration	Description
1	DC24V+	Voltage: 24 VDC ±10% Current: 150 mA Start Current: 4.4 A 2ms	--	Supply voltage
2	DC24V-			
3	FG	Field Ground	--	Field ground
4	Analog Out +	4-20 mA or 0-20mA configurable Load resistance < 600 Ω	Flow reading with 4-20 mA Standard full scale flow range of each sensor model.	Flow rate signal. Update rate is 10ms.
5	Analog Out -			
6	Digital Out1 +	Max. rating 30 V DC, 20 mA Open collector Configurable as Alarm High, Alarm Low, Measurement Error, Volume Counter Pulse, Volume Counter Alarm, Flow as Frequency, Bubble Detect	- Parameter: Flow Alarm High - Setting: 105% of full scale - Normally opened	Contact is made, when 105% of full scale flow rate is exceeded.
7	Digital Out2 +		- Parameter: Flow Alarm Low - Setting: -5% of full scale - Normally opened	Contact is made, when -5% of full scale flow rate is reached.
8	COM		-	Common Digital Out ground.
9	Digital In +	No-voltage contact or transistor open collector	Zero Adjustment	Is needed, if zero adjustment wants to be triggered by PLC or when volume counter function is used (integration of flow with volume detection)
10	Digital In -			
11	RS485 +	RS485	*MODBUS* Protocol	Digital communication in a sensor array. or configuration with configuration SW.
12	RS485 -			

Table 9: Standard configuration of electrical interface (PLC)

4.2.2 Typical Setups Using the PLC Interface

The *Figure 15* and *Figure 16* show typical setups for *LEVIFLOW™* converters using the PLC interface.

Figure 15 is an example how to connect the *LEVIFLOW™* converter to a relays to control a shutoff valve by a digital output. Note that if protective diode is normally not integrated within relays it has to be connected additionally as shown in *Figure 15*. This setup additionally shows how to connect a push-button to digital input (e.g. for reset of volume counter, which has to be configured with *LEVIFLOW™* configuration software).

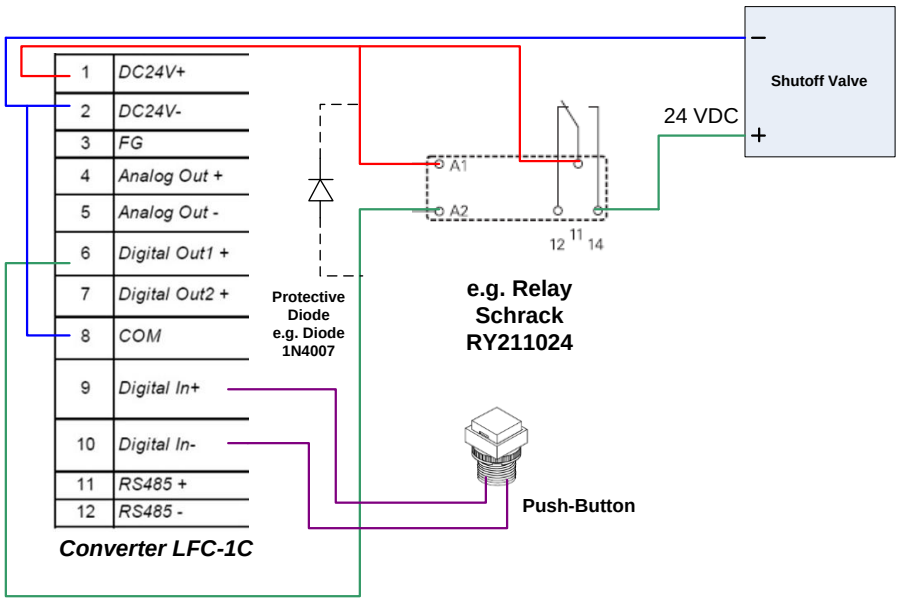


Figure 15: Controlling a shutoff valve by digital output of LFC-1C-xx converters

Figure 16 shows an example how to connect digital in-/outputs and analog output of *LFC-1C-xx* to a *Levitronix®* Pump System.

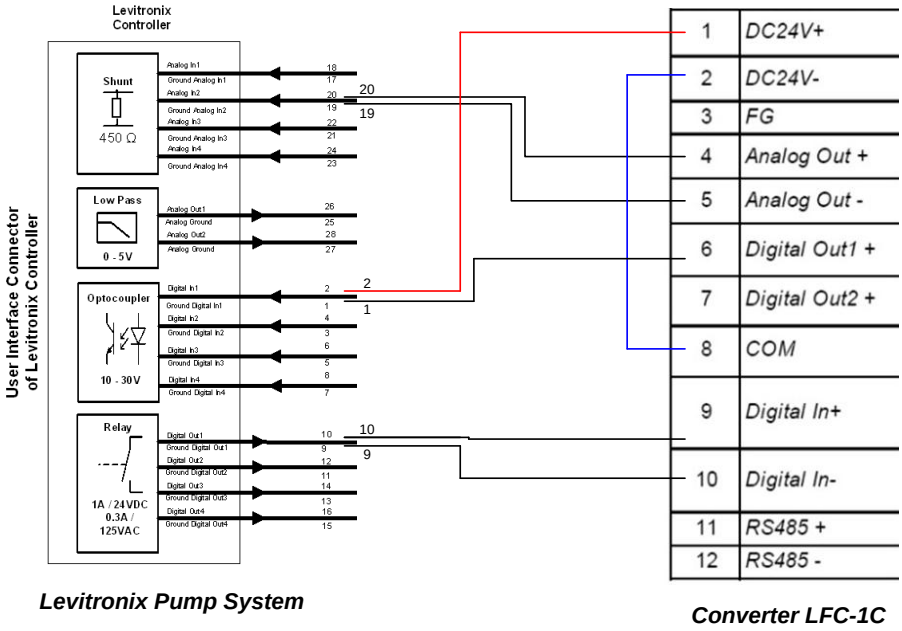


Figure 16: Usage of PLC of LFC-1C-xx converters with a Levitronix Pump System

4.2.3 Operation with RS485

Operation with communication over an RS485 bus is possible. The according *MODBUS* protocol can be requested at *Levitronix®.*

4.2.4 Display Messages

Priority	Event	Display Message Digit 1 – 4				Status Description
		1	2	3	4	
1	Download	–	d	l	-	- Firmware download running - Blinking
2	Volume counter reset	C	L	E	A	- Volume counter is reset
3	Zero adjustment	0	A	d	J	- Zero adjustment is running (approximately 2 sec.) - Blinking
4	Zero adjustment error	0	–	E	r	Zero adjustment error
5	Volume counter pulse set error	P	–	E	r	Volume counter pulse length is too big to show full scale flow on digital output
6	Measurement error	B	–	E	r	- Sensor signal error -> empty sensor, bubble, etc. - Blinking
7	Warning upper limit	H				- Displays upper limit warning (with flow rate display by turns) - Blinking with flow rate
	Warning lower limit		L			- Displays lower limit warning (with flow rate display by turns) - Blinking with flow rate
	Exceeds vol. counter value H			H		- Volume counter value exceeded preset H - Blinking with flow rate
	Exceeds vol. counter value HH				H	- Volume counter value exceeded preset HH - Blinking with flow rate
8	Flow rate display	X.	X	X	X	Flow rate range: 0.000 ~ 9.999 L/min
		X	X.	X	X	Flow rate range:10.00 ~ 99.99 L/min

Table 10: Display messages of LFC-1C / LFC-1C-F4 converter

4.3 System Operation with Converter *LFC-6C*

4.3.1 Operation with RS485

Standard operation with *LFC-6C* is done with the RS485 interface. The according *MODBUS* protocol can be requested at *Levitronix®.*

4.3.2 Standalone Operation with Display

The *LFC-6C* can be used as standalone device, where the flow values can be read on the display. The channel to be read can be chosen with the channel selection potentiometer on the display (see *Figure 11d*).

4.3.3 Display Messages

The 6-channel converter *LFC-6C* displays basically the same messages as the single channel converter *LFC-1C / LFC-1C-F4* (see *Table 10*).

Additionally *LFC-6C* shows on the display on the right side six LEDs (see *Figure 11d*). LEDs indicate which channel has measurement error active (when channel selection is set to a specific channel 1-6) or indicates, which flow is shown in display at the moment (when channel selection is set to 0).

4.4 Operation with LEVIFLOW Configuration Software

For debugging, data collection and configuration of the flowmeter system the *LEVIFLOW™ Configuration Software* is available at *Levitronix®*. Contact Levitronix for a sample of the configuration software and the according manual (*Levitronix®* Doc.# *PL-4501-00*). An approved USB to RS485 adaptor with the according connection cable can be ordered according to the information in *Table 3*.

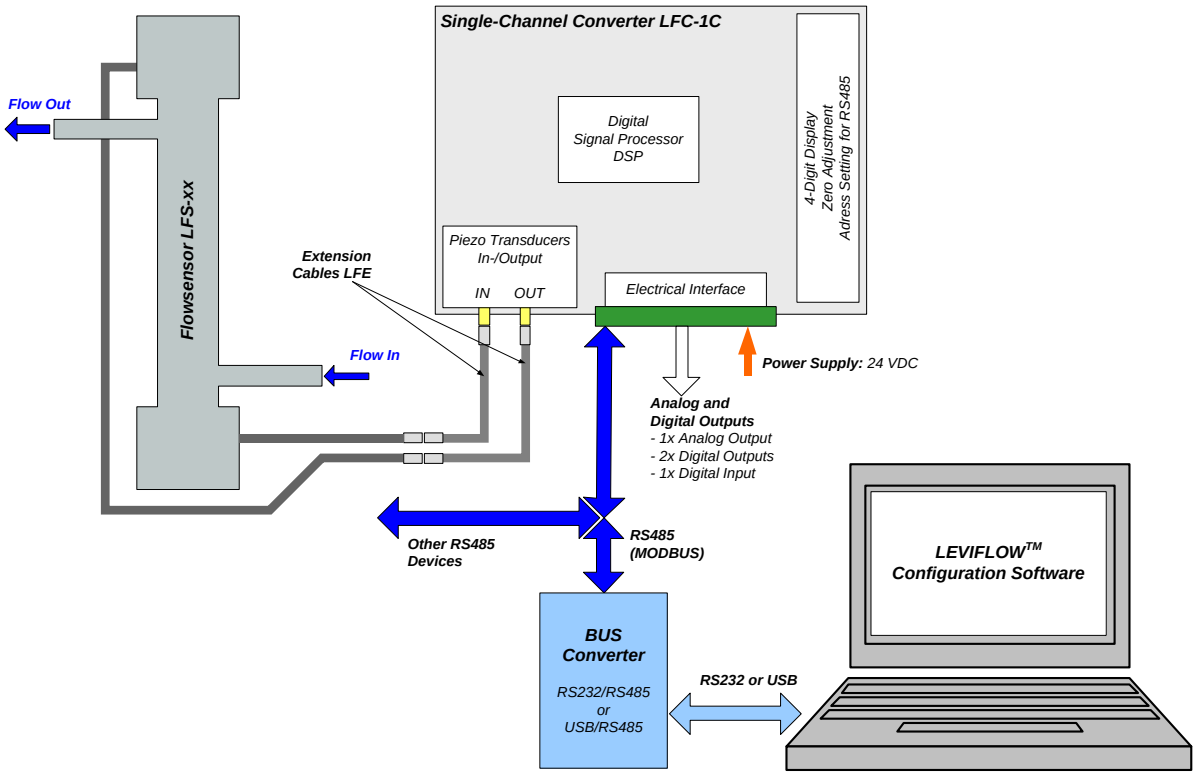


Figure 17: System operation with LEVIFLOW™ configuration software

5 Inspection and Maintenance

The *LEVIFLOW™* ultrasonic flowmeters do not require special maintenance since there are no moving parts that can be subjected to wear and tear. However, the following periodical checks are recommended to ensure smooth and reliable operation:

1. Check for excessive mechanical stress onto the flow sensor body for example caused by bended piping.
2. Inspect for loosen connections caused by excessive pipe vibrations.
3. Inspect the sensor visually for any deposits, excessive bubbles or foreign materials in the measuring tube.

6 Troubleshooting

6.1 Common Troubles

#	Phenomenon	Possible Cause	Countermeasure
1	"0-Er" indication on converter display	Zero adjustment is not working properly.	Check if the circuit is filled with liquid and the flow is actually zero, and conduct zero adjustment again
2	"b-Er" indication on converter display	Incorrect signal received from measurement in the sensor.	- Check if measuring tube is filled with liquid - Check if there is something in the measuring path disturbing the ultrasonic wave (bubbles, solid substances etc) - Check if excessive noise is generated in the neighborhood of the sensor (heavy devices like motors, high voltage cables etc) - Check if the cables are connected correctly and not damaged
3	Zero flow is indicated even if there is flow in the hydraulic circuit	Wrong parameter and mechanical setup of sensor.	- Check if the parameters have been set to the optimal values - Check if the flow direction is correct
4	The flow indication does not match the real flow	Wrong parameter settings, excessive bubbles or solids in the measurement path.	- Check if the parameters in the converter are set correctly - Inspect the flow path for stagnating solids - Inspect the measurement path for excessive bubbles
5	Above full scale flow is indicated or the flow signal is unstable	Wrong parameter settings, excessive bubbles or solids in the measurement path.	- Check if the parameters in the converter are set correctly - Inspect the flow path for stagnating solids - Inspect the measurement path for excessive bubbles

Table 11: Potential troubles and the possible countermeasures

6.2 Troubleshooting with *LEVIFLOW™* Configuration Software

More detailed error analysis can be done with the *LEVIFLOW™* configuration software. Contact Levitronix for a sample of the configuration software and the according manual (*Levitronix®* Doc.# *PL-4501-00*).

7 Technical Support

For troubleshooting, support and detailed technical information contact *Levitronix® Technical Service Department*:

Levitronix®
Technical Service Department
Technoparkstr. 1
CH-8005 Zurich
Switzerland

Phone for US: 888-569 07 18
Phone for outside US: +1 888-569 07 18
E-Mail: support@levitronix.com

8 Appendix

8.1 Regulatory Status

8.1.1 CE Marking

The ***LEVIFLOW™*** flowmeters, in its various configurations as listed below,

Part Name	***Description***
LFS-xx	Flowsensors: *LFS-008* (0 – 800 mLpm), *LFS-04* (0 - 4 lpm), LFS-08 (0 - 8 lpm), *LFS-20* (0 - 20 lpm), *LFS-50* (0 - 50 lpm), *LFS-80* (0 - 80 lpm)
LFC-1C	Single-Channel Converter for LFS-series sensors: 24V DC supply input
LFC-6C	6-Channel Converter for LFS-series sensors: 24V DC supply input
LFC-1C-F4	Single-Channel Converter for Low-Flow Sensor: 24V DC supply input

are in conformity with the essential requirements of the *EMC Directive 2004/108/EC* and the *Pressure Equipment Directive 97/23/EC*.

The following particular harmonized standards of the *EMC Directive*

EN 61000-6-4	**Generic Emission standard for industrial environments**
EN 55011	Electromagnetic Disturbances
EN 61000-6-2	**Generic Immunity standard for industrial environments**
EN 61000-4-2	Electrostatic Discharge Immunity
EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity
EN 61000-4-4	Electrical fast transient/burst immunity
EN 61000-4-5	Surge immunity
EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields

are tested at

Test Laboratory: Hochschule für Technik Zürich
EMV Labor, Technoparkstr. 1
CH-8005 Zurich, Switzerland
Swiss certification number = STS 404

The *Pressure Equipment Directive 97/23/EC* is followed according to *Category I Modul A* (internal quality control). For max. pressure validation the following standard is used:

EN ISO 15494	Plastic piping system for industrial applications

8.2 Symbols and Signal Words

Symbol / Signal Word	Description	Type	Source
DANGER	Indication of an imminently hazardous situation that, if not avoided, will result in death or severe injury. Limited to the most extreme situation	Signal word	SEMI S1-0701
WARNING	Indication of a potentially hazardous situation which, if not avoided, could result in death or severe injury.	Signal word	SEMI S1-0701
CAUTION	Indication of potentially hazardous situations which, if not avoided, could result in moderate or minor injury. Also alert against unsafe practice. Without safety alert indication of hazardous situation which, if not avoided, could result in property damage.	Signal word	SEMI S1-0701
	Safety alert for “Warning” and “Caution”	Safety alert	SEMI S1-0701
	Safety alert for “Danger”	Safety alert	SEMI S1-0701
	Caution (refer to accompanying documents) (is used on article labels for reference to manual)	Refer to manual	ISO 3864
	Toxic material, poison	Hazard identification	IEC 61310
	Corrosive material, corrosion	Hazard identification	IEC 61310
	Cut/sever hand, sharp object	Hazard identification	ANSI Z535.3
	Strong magnetic field	Hazard identification	SEMI S1-0701
	Danger: electricity, electrical hazard	Hazard identification	IEC 61310, ISO 3864
	Wear safety gloves	Hazard avoidance Mandatory action	IEC 61310
	Wear face shield	Hazard avoidance Mandatory action	SEMI S1-0701
	Unplug power line	Hazard avoidance Mandatory action	SEMI S1-0701
	No pacemakers	Hazard avoidance Prohibition	SEMI S1-0701

Table 12: Safety symbols and signal words